Lecture 14

Relays

Mechanical relay

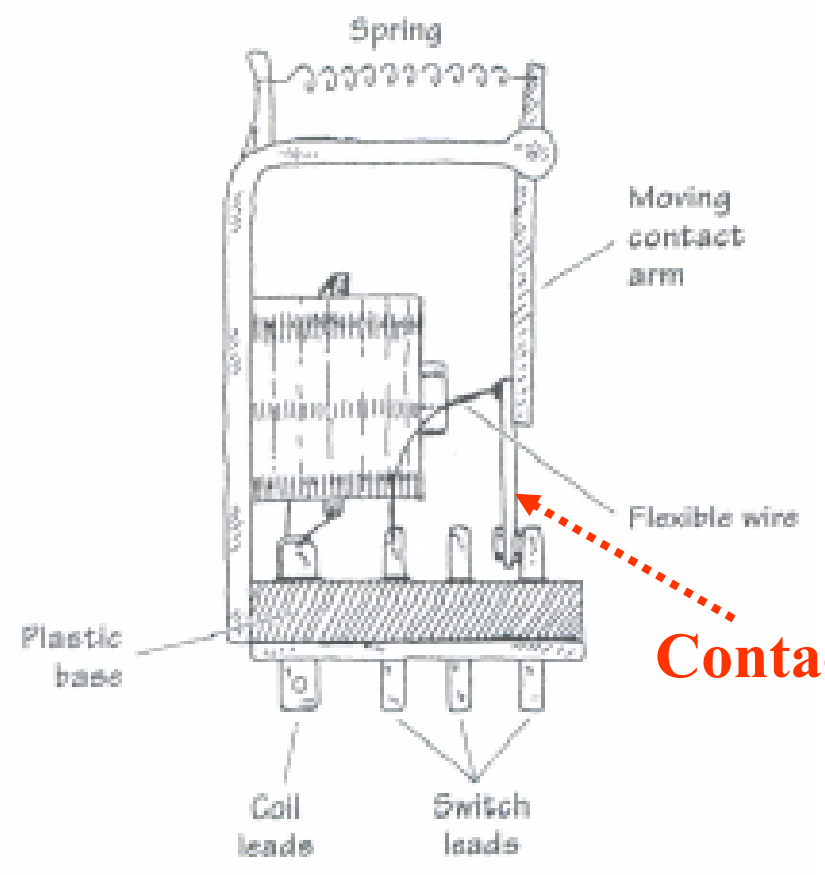
- Relays are electrically actuated switches
  - Mechanical relays
  - Reed relays
  - Solid-state relays
- A relay consists of an electromagnetic coil and one or more pairs of contacts

Miniature relay

Reed relay

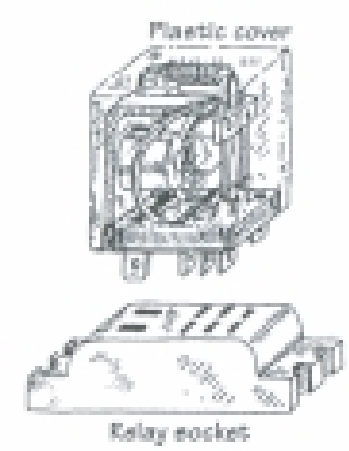
Solid-State relay

Mechanical Relays

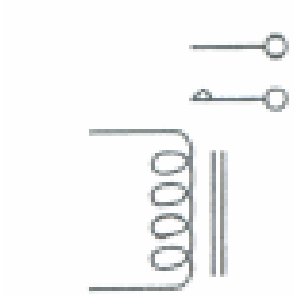


- Designed for high currents
  - Typically from 2A to 15A
- Relatively slow switching
  - 10ms to 100ms

Contact switch

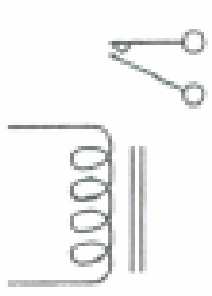


Common Symbols for Relays

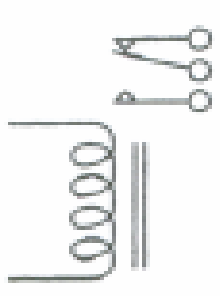


SPST (normally open)

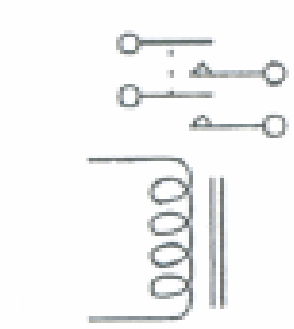
Single Pole, Single Throw



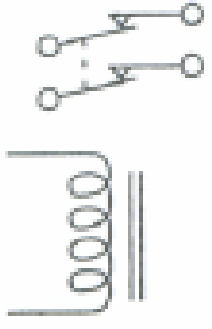
SPST (normally closed)



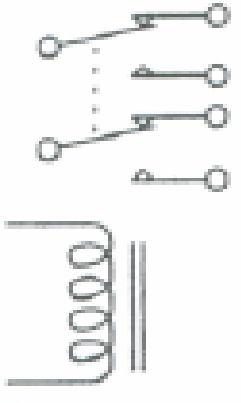
SPDT



DPST (normally open)



DPST (normally closed)

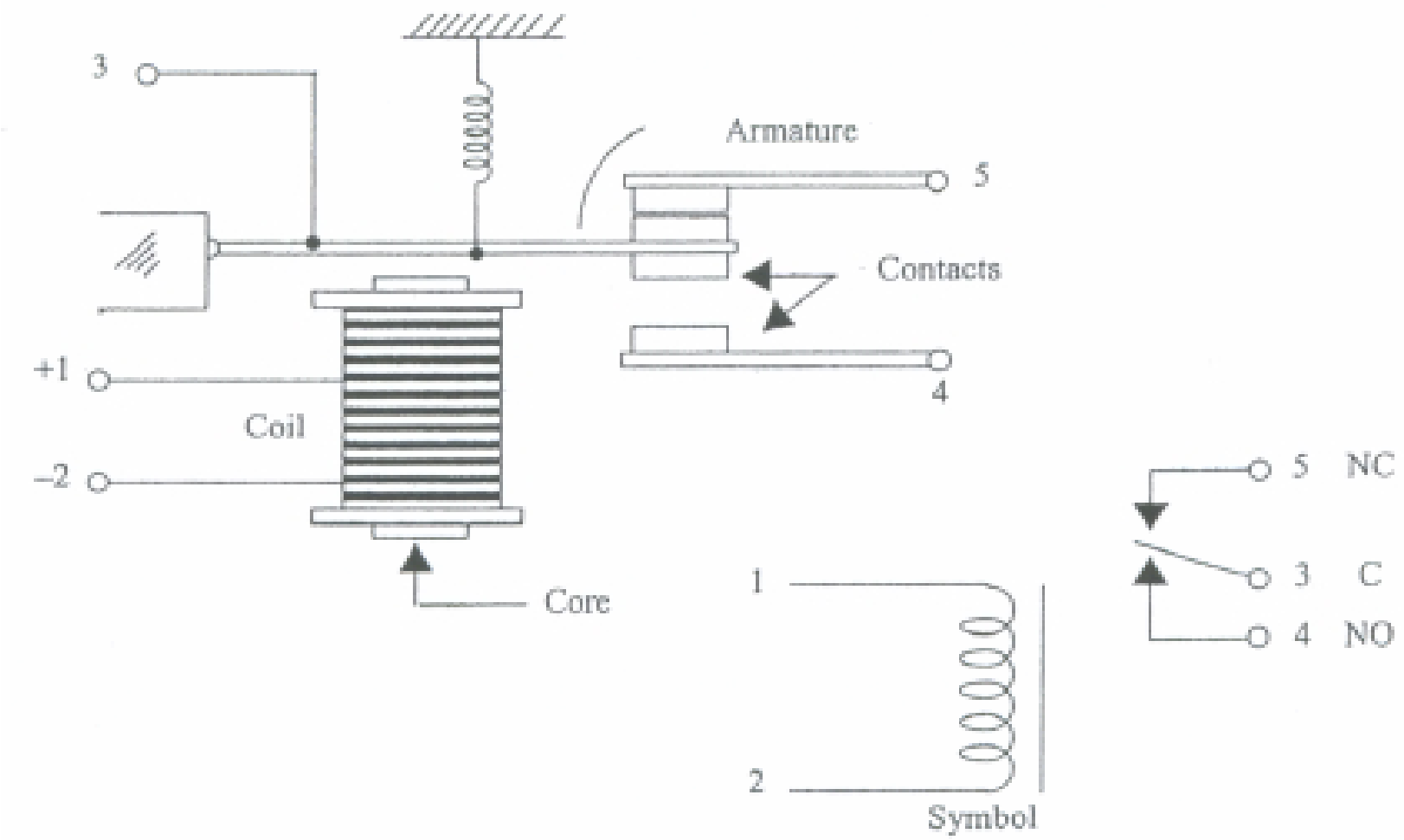


DPDT

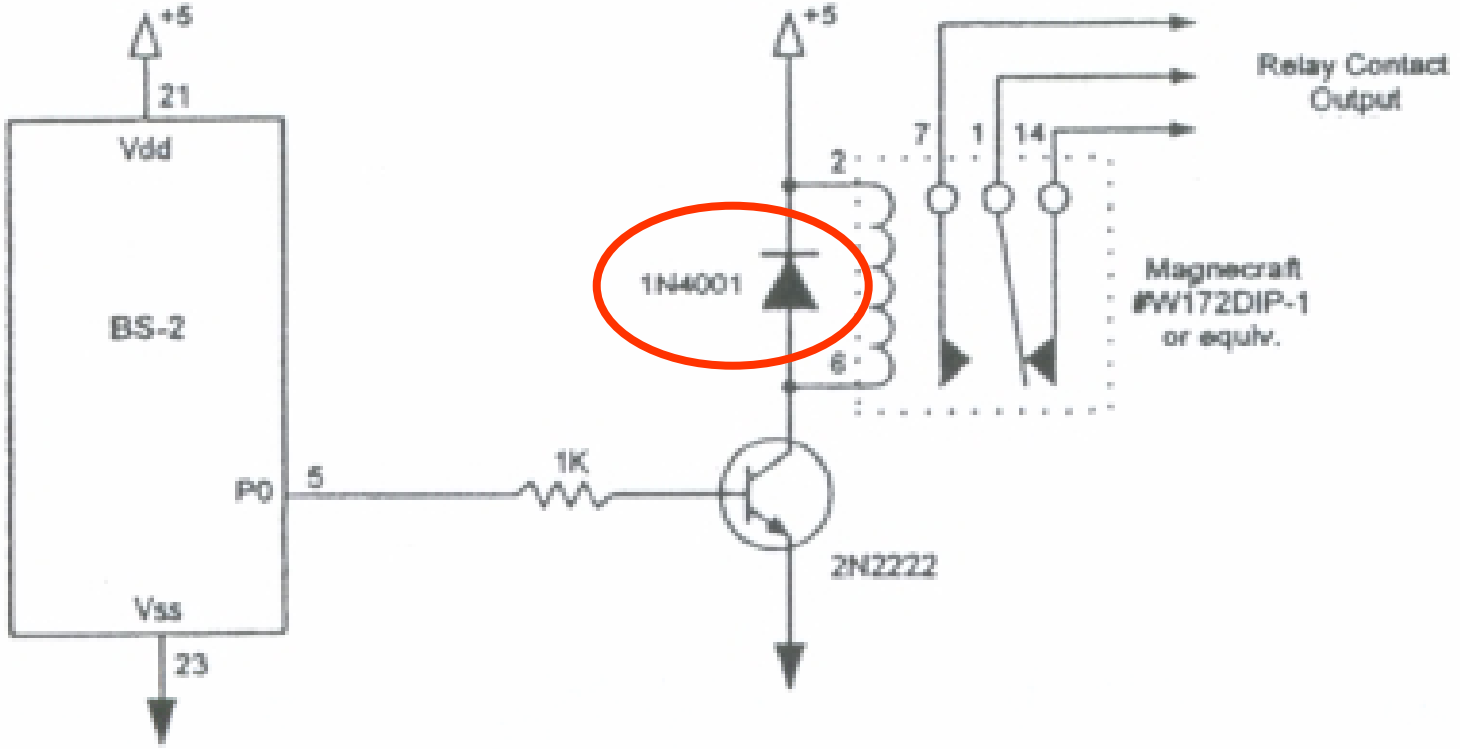
Notes About Relays

- To make a relay change states, the voltage across of its magnetic coil should be at least within ± 25 percent of the relay's specified control voltage rating ($Vc \pm 0.25 \times Vc$)
- Sudden changes in current will create voltage spike, to avoid this is to use transient suppressors

Electromechanical Relay

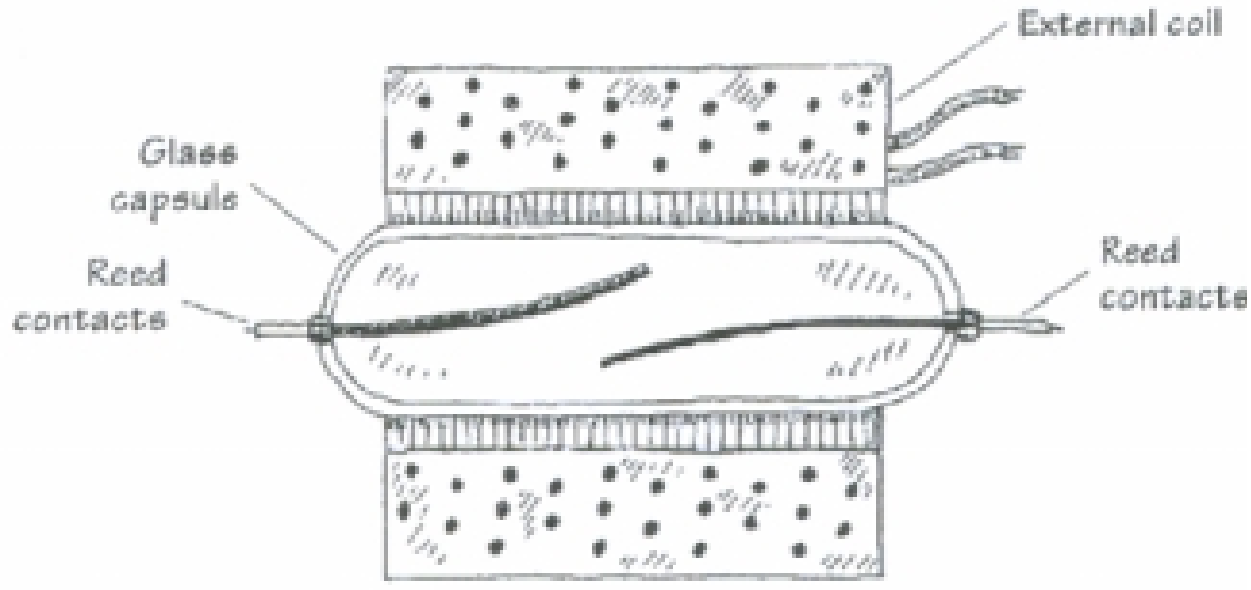


Relays with BS2

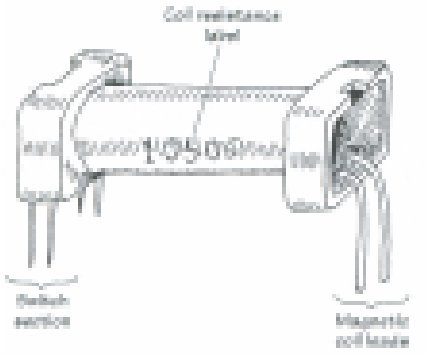


Using an NPN transistor to drive a relay

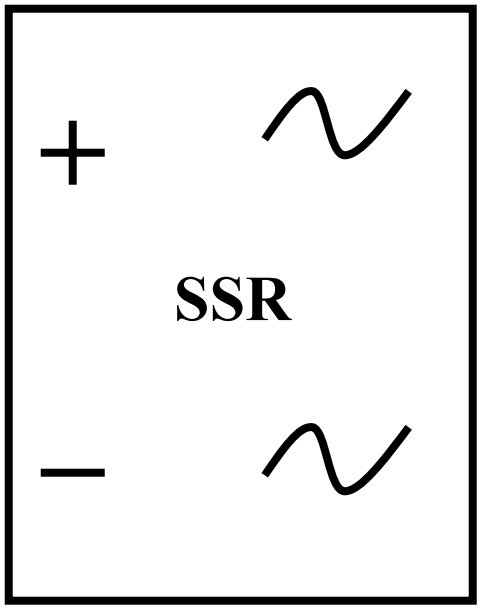
Reed Relays



- Designed for moderate currents
  - Typically from 500mA to 1A
- Moderately fast switching
  - 0.2ms to 2ms

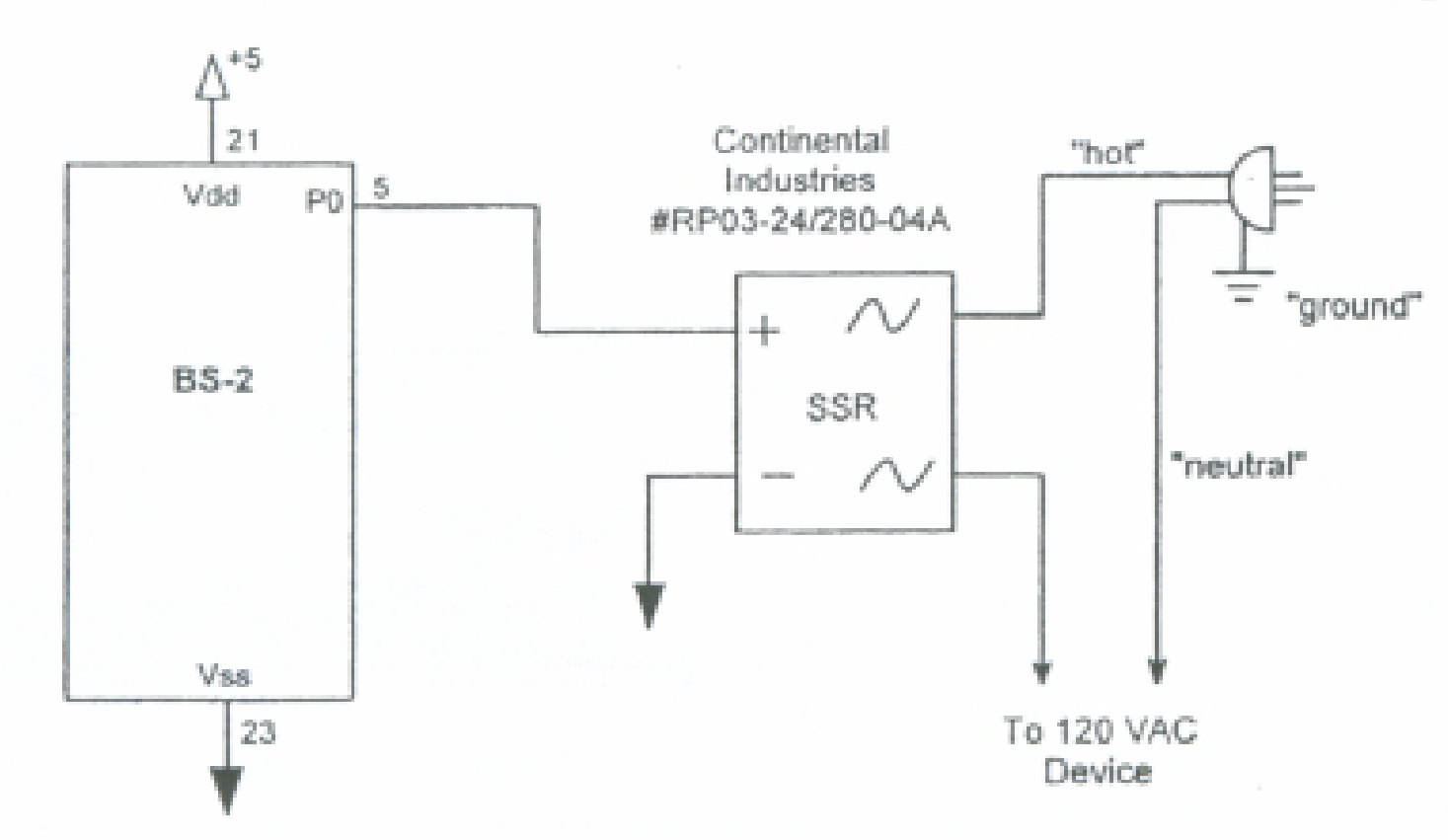


Solid State Relays



- Wide range of current ratings
  - from a few μA to 100A
- Extremely fast switching
  - 1 to 100 ns

Solid State Relay with AC



Extremely caution with 120V AC !!

Relay Experiments

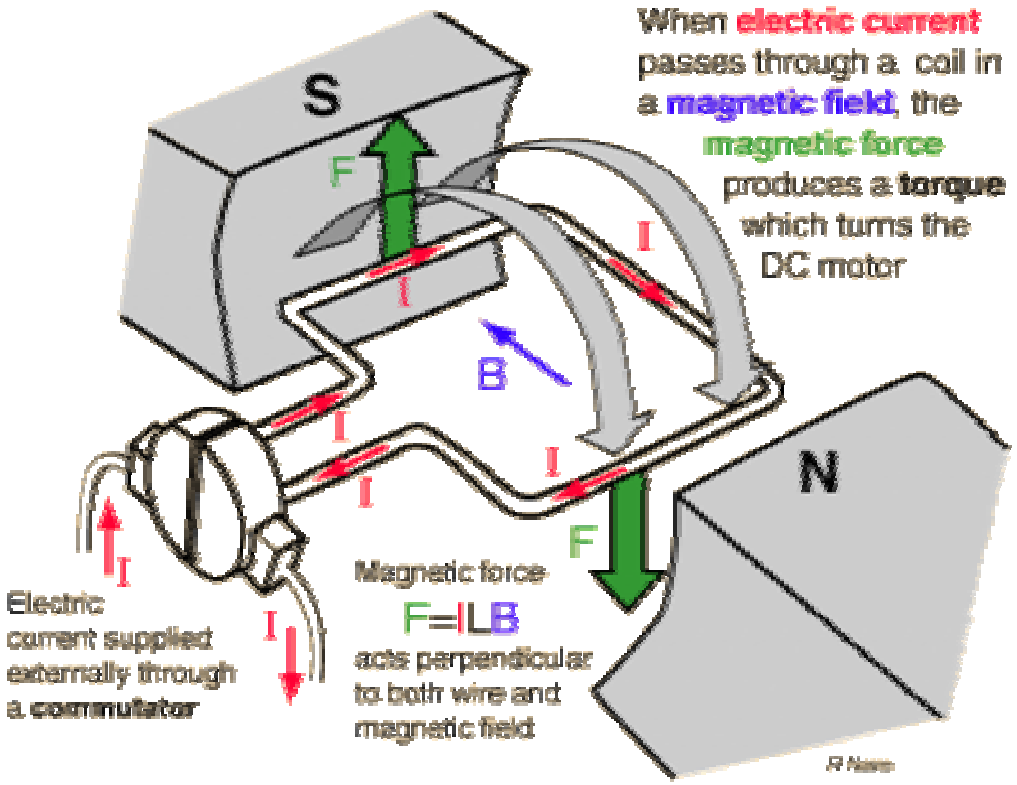
Experiments	Chapters
What's micro controller	
Basic A and D	
Earth measurements	
Robotics	
StampWorks	
Others	

Lecture 15

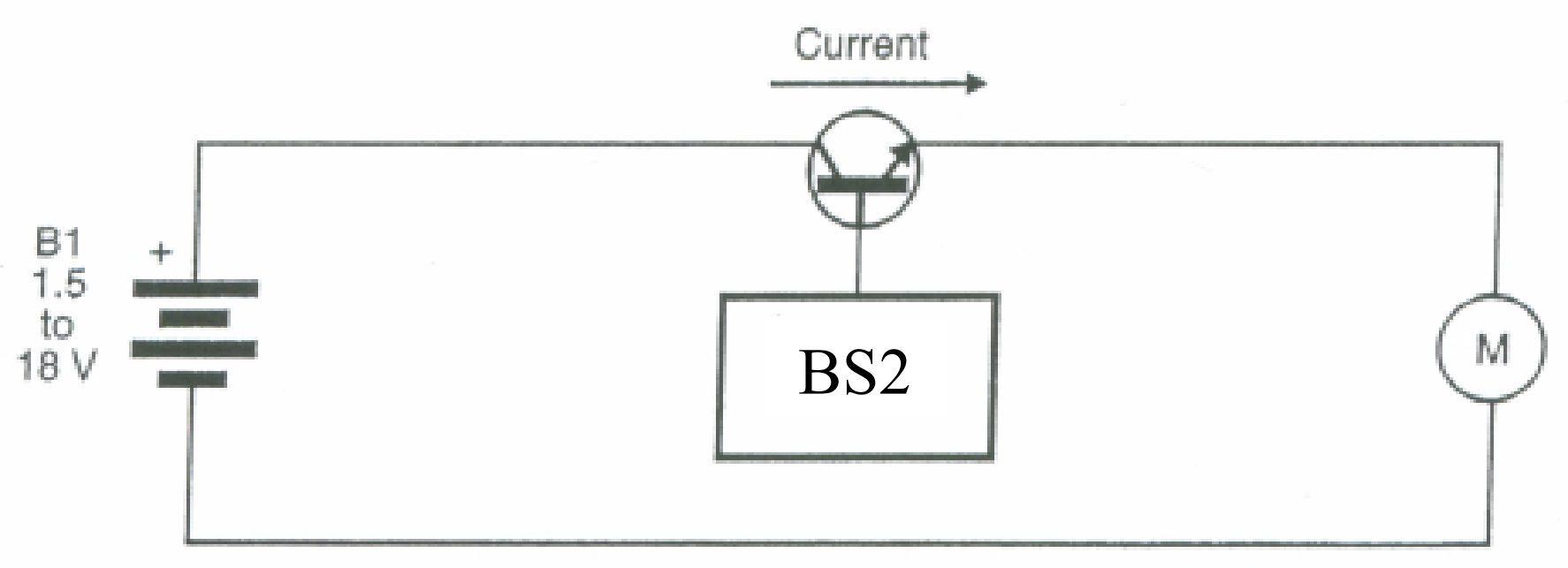
DC Motor

- DC motors are
  - Simple two-lead
  - Electrically controlled
- The voltage range of the DC motor is
  - 1.5V ~ 48V

DC Motor: How It Works



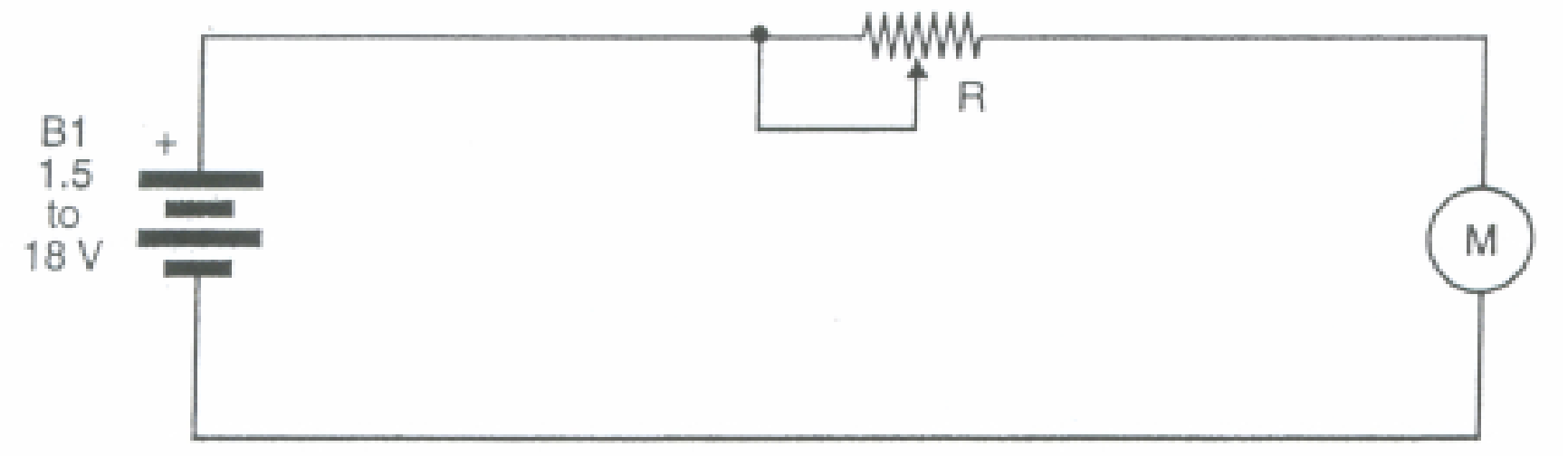
Turning a DC Motor On/Off



DC Motor Speed Control 1

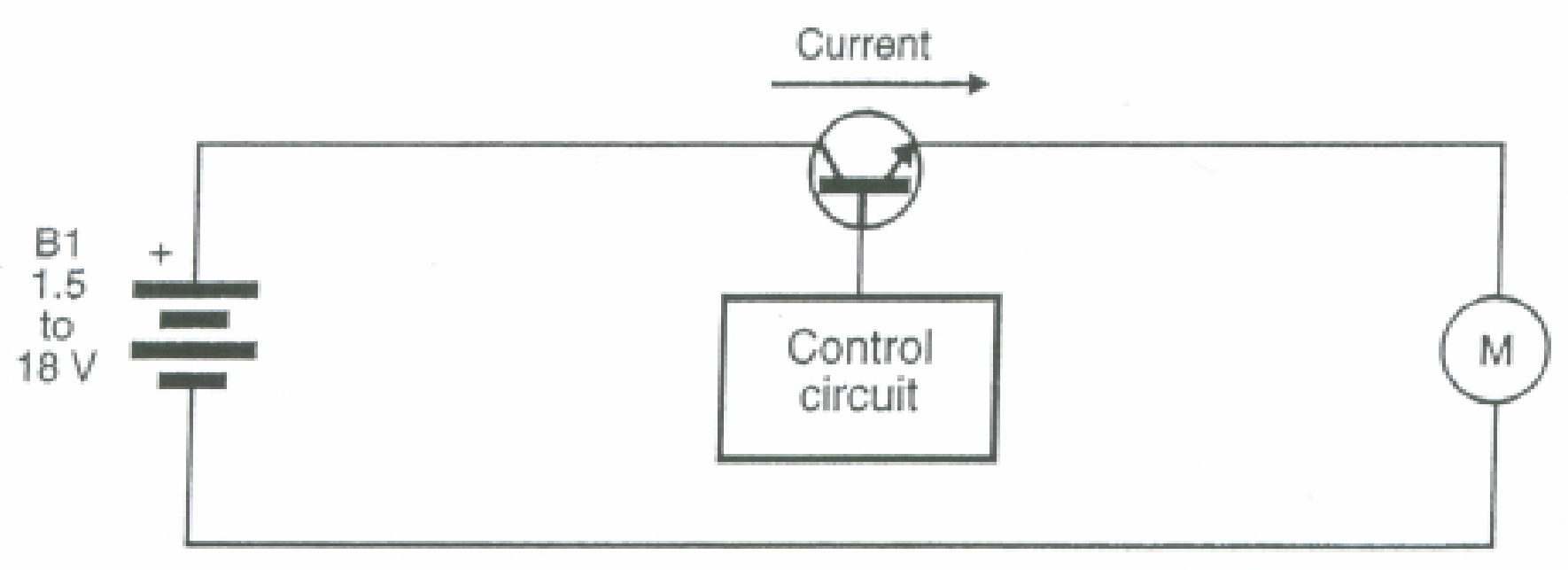
- When the voltage applied to a DC motor
  - Lower than nominal voltage → Motor runs slower
  - Higher than nominal voltage → Motor runs faster
- Linear control
  - Connect a potentiometer in series with motor
  - Use a transistor (BJT/FET) as a variable resistor

DC Motor Speed Control 2



Linear control using a potentiometer in series with motor

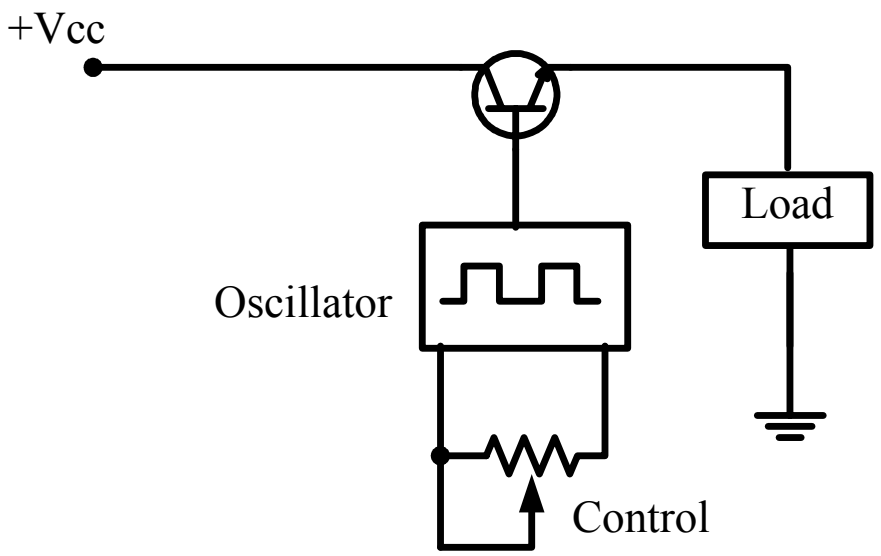
DC Motor Speed Control 3



Linear control using a bipolar transistor

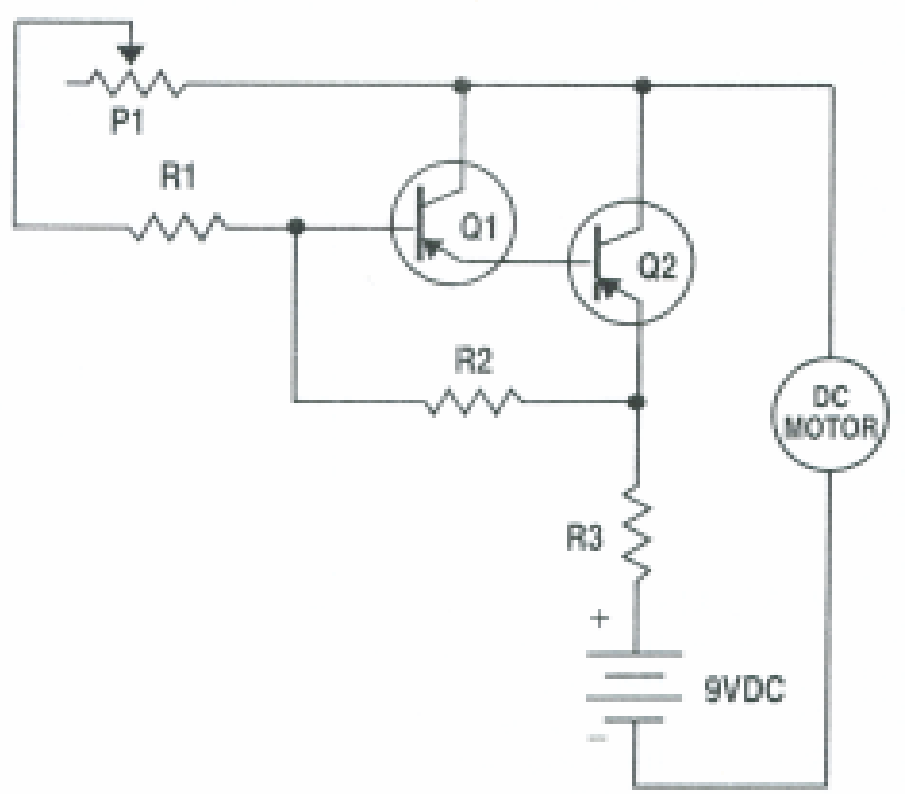
Pulse Width Modulation 1

- An efficient method to deliver controlled amount of power to loads
- Use square voltage pulses to power a load
- The amount of power deliver to load depends on the duration of each pulse



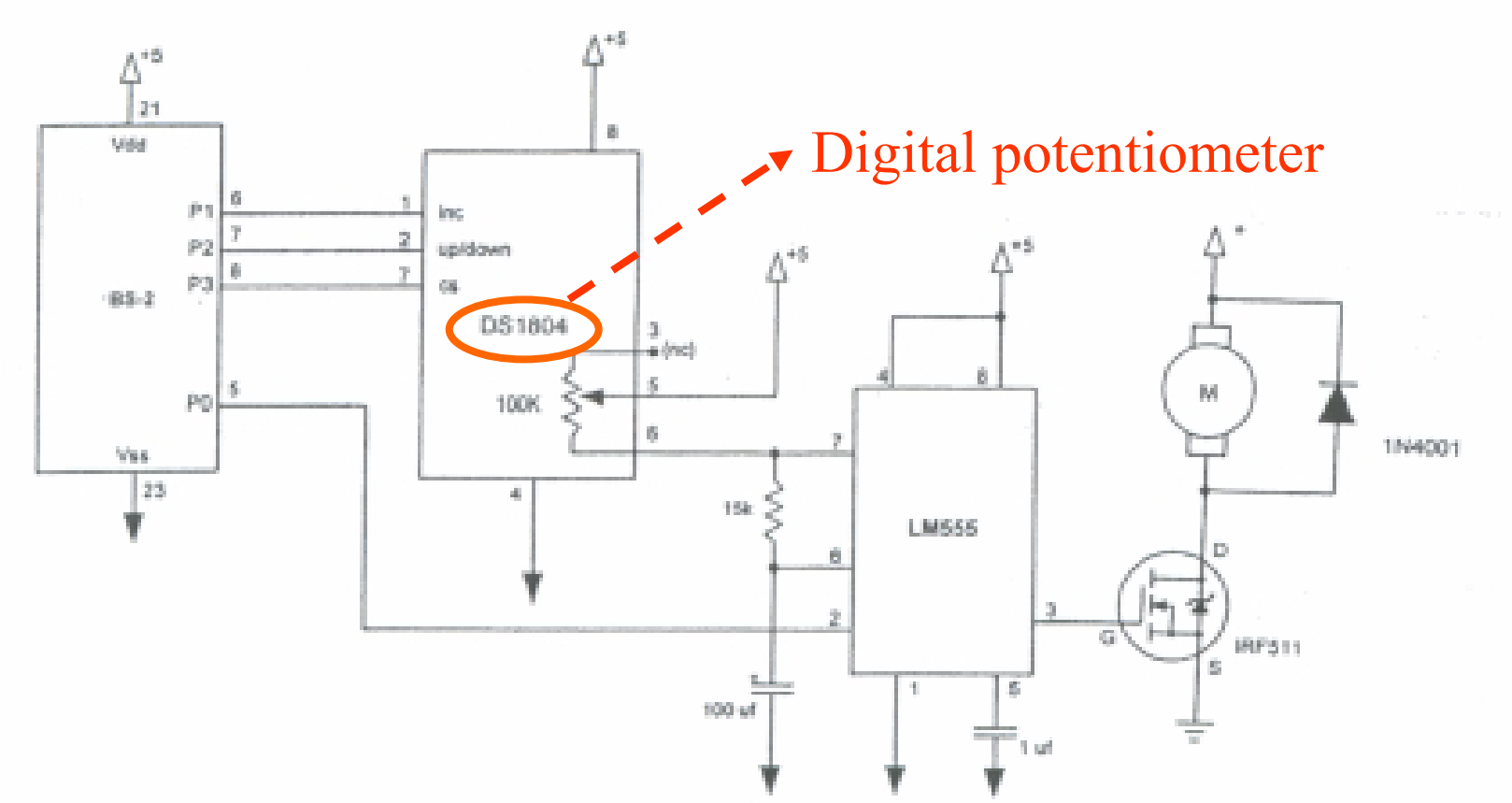
Basic PWM control

Pulse Width Modulation 2



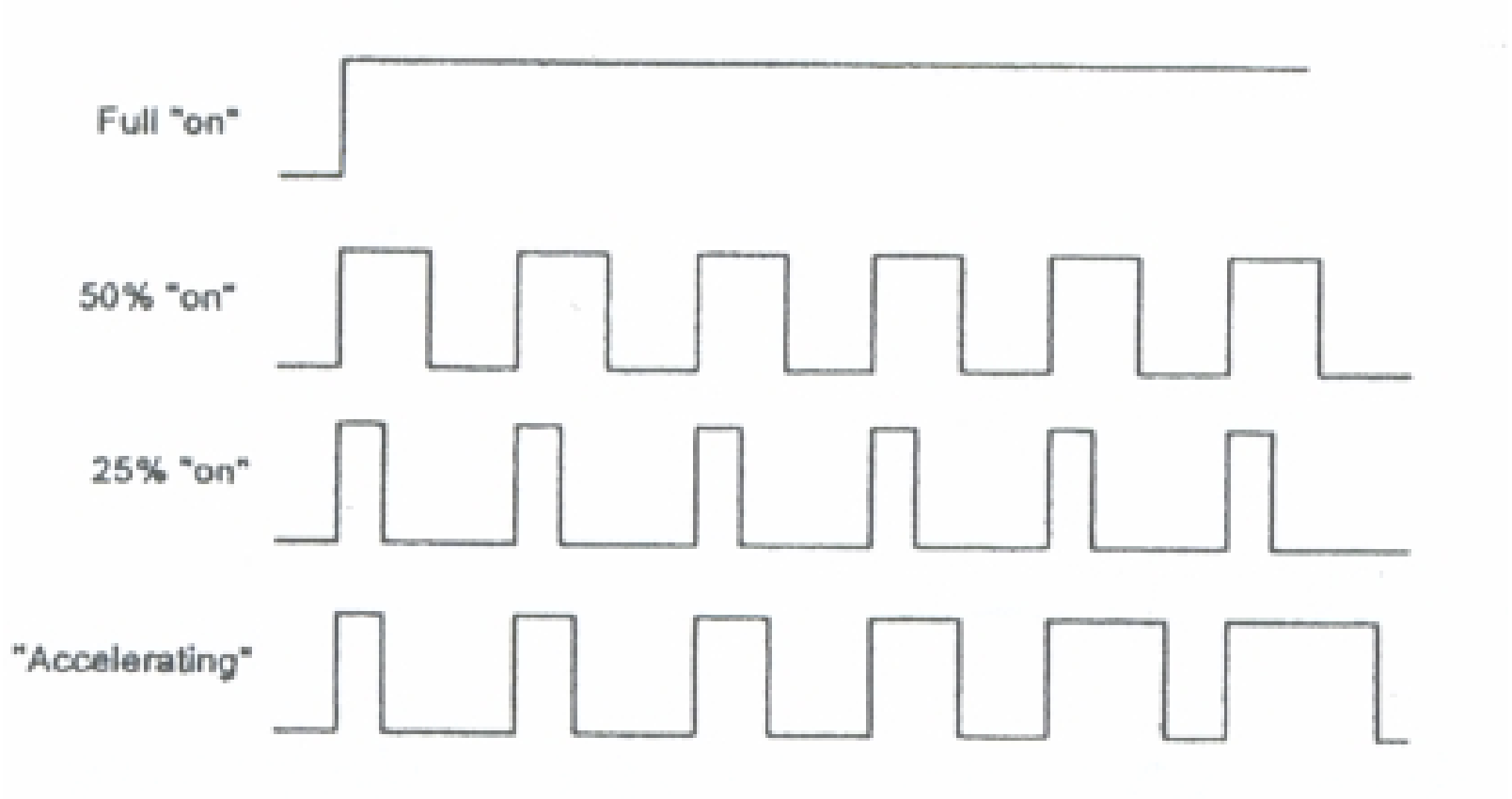
P1	50k Potentiometer
M1	DC Motor
Q1	PNP Transistor
Q2	PNP Transistor
R1	1kΩ
R2	15kΩ
R3	12Ω

Pulse-Width-Modulation 3



Controlling on-time duration of a DC motor

Pulse-Width-Modulation 4



PWM